LABORATORY APPARATUS WITH TWO CABINETS

This invention relates to a laboratory apparatus and more particularly but not solely to a laboratory apparatus for use in the In Vitro Fertilisation treatment of infertility.

Over the course of the last 25 years or so, infertile couples have been able to take advantage of an In Vitro Fertilisation or so-called IVF technique to improve their chances of reproduction, whereby the female is treated with hormones such that a large number of unfertilised eggs or so-called oocytes are produced. The oocytes are extracted from the patient and taken to a laboratory usually situated in the next room, where they are washed and counted.

It is desirable to collect a large number of oocytes so that the chances of a successful embryo being produced are increased. Accordingly, the above process is repeated several times until a suitable number of oocytes have been collected.

The oocytes are then fertilised, either by the introduction of spermatozoa into the dish containing oocytes or by using micromanipulators to inject spermatozoa into individual oocytes. The fertilised oocytes or so-called Zygotes are then transferred to an incubator to an environment which is controlled to closely resemble the conditions inside the body. Typically, the carbon dioxide level inside the body is constant at 5%, thereby keeping the pH value constant. Also, the temperature is substantially constant at 37°C.

The Zygotes are kept inside the incubator for a period of at least several days until the embryo stage is reached. As hereinbefore described, a plurality of oocytes are collected and fertilised and accordingly, it is possible that several manage to reach the embryonic stage. At this point, one or more of the best embryos are selected and implanted into the female,

although it will be appreciated that the implantation of multiple embryos could result in a multiple pregnancy.

Unfortunately, the success rate of the above-mentioned IVF procedure is low and many couples have to undergo the procedure several times before pregnancy is achieved. It will be appreciated that this is both expensive and distressing.

Following a detailed study of the above-mentioned IVF procedure, we have realised that a high proportion of the failures are due to the effects of the environment in which the culture is kept at the various stages following the extraction of the oocyte from the female and prior to implanting the cultured embryo into the female uterus.

The first problem is that, following extraction from the female, the oocytes are exposed to the normal room environment whilst they are washed and counted. This problem is exacerbated by the fact that a delay of several minutes or so is incurred each time the embryologist has to wait for further oocytes to be collected from the female.

The second problem is that, once inside the incubator, the controlled environment therein is regularly disturbed each time the incubator is opened to add or remove cultures. It will be appreciated that the incubator contains cultures from many couples which are continuously being added and removed. Each time the incubator is opened, the environment therein mixes with the room environment and it can take a considerable time to recover the ideal environment once the door is closed.

Another problem is that each culture has to be regularly examined, which necessitates removal of the culture from the incubator and inspection, for example under a microscope, prior to replacement in the incubator. This process of inspection further disturbs the environment within the

incubator and exposes the culture to the room environment whilst the inspection is carried out.

We have now devised a laboratory apparatus particularly suited for use in the IVF process, which alleviates the above-mentioned problems.

In accordance with this invention, there is provided a laboratory apparatus comprising first and second cabinets interconnected by a passageway and means for closing the passageway, the first cabinet having an open front and means for circulating air within the cabinet, the second cabinet being substantially sealed and having means for controlling the temperature within the cabinet, means for controlling the level of at least one gas within the cabinet and means to allow external inspection of the contents of the cabinet.

In use, following extraction of the oocytes, they are taken to the first cabinet where they can conveniently be washed and counted through the open front, which affords ready access into and out of the cabinet. The air within the first cabinet is circulated and thus the oocytes are contained in a substantially constant environment. The oocytes are contained in this constant environment until a sufficient number have been collected. The oocytes are then mixed with the spermatozoa before being transferred into the second cabinet through the passageway, by opening the closure there between.

The closure serves to contain air within the second cabinet, although any air which does pass into the second cabinet during transfer will merely be air from the first cabinet and not that from the room environment.

Once inside the second cabinet, the cultures are kept in an environment in which the gas and temperature levels are controlled, preferably to substantially resemble the conditions

that would be present inside the body.

Any cultures which are added or removed from the second cabinet have to pass through the passageway via the first cabinet and thus the environment inside the second cabinet is not directly exposed to the room environment.

The inspection means enables the cultures in the second cabinet to be inspected, thereby avoiding having to regularly remove them from the cabinet.

The present invention therefore retains the cultures in a stable and controlled environment substantially all of the time from extraction of the oocytes to implantation of the embryo. In this manner the success rate of the IVF procedure is greatly increased over the traditional procedure.

Preferably the circulated air inside the first cabinet is passed through a filter in order to alleviate risk of contamination of the culture by airborne particles.

Preferably the airflow inside the first cabinet is a laminar flow, which preferably extends downwards, parallel to said open front of the cabinet. This laminar flow helps to constrain the air within the cabinet.

Preferably means are provided for controlling the temperature inside the first cabinet. In order to conserve energy and avoid the need to heat the air inside the first cabinet, the heating means is preferably arranged to heat a surface inside the first cabinet on which containers containing matter such as the oocytes can be placed.

Preferably the means for closing the passageway comprises first and second closures which are spaced apart on the passageway with a space there between. Thus, in order to transfer the cultures between the first and second cabinets, they have to pass through two closures which further serve to

isolate the environment than the second cabinet, by opening one closure, placing the cultures in the space between the two closures and closing the open closure before opening the second closure.

Preferably means are provided for changing the air in the space between the two closures, so that the environment therein is as close as possible to that in the second cabinet before the closure isolating the space and the second cabinet is opened. This further serves to minimise any disruption to the environment inside the second cabinet when cultures are added or moved.

Preferably the closures are interlocked to provide a time delay between opening of the closures.

Preferably means are provided for transporting the cultures between said first and second cabinets through the passageway.

Preferably said means for controlling the level of at least one gas within the cabinet is arranged to control the level of carbon dioxide and/or oxygen within the cabinet.

Preferably means are provided for controlling the humidity inside the second cabinet.

Preferably the pressure inside the second cabinet is greater than atmospheric pressure to help prevent the ingress from the room into the cabinet.

Preferably the second cabinet comprises a transparent front wall, through which the cultures can be inspected.

A microscope or a camera may be provided inside the second cabinet to further enable inspection of cultures therein.

Preferably means are provided to enable manipulation of the cultures in the second cabinet. Preferably said means

enabling manipulation comprises at least one port in the front wall of the second cabinet, through which a person's hand can sealingly extend.

An embodiment of this invention will now be described by way of an example only and with reference to the accompanying drawings, in which:

Figure 1 is a front view of a laboratory apparatus in accordance with this invention for use in the IVF procedure; and

Figure 2 is a sectional view along the line I-II of Figure 1.

Referring to Figures 1 and 2 of the drawings, there is shown a laboratory apparatus for use in the IVF procedure comprising a first central cabinet 10 disposed between two identical outer cabinets 11. Each of the outer cabinets 11 is connected to the central cabinet by a respective duct 12, which respectively provide a sealed passageway between the interiors of the respective cabinets 10, 11. The central cabinet 10 comprises an open front wall 13 which allows easy access to the interior of the cabinet 10. A heater 14 is disposed under the floor of the interior of the cabinet 10. Apertures 15 are formed in the floor of the interior of the cabinet 10 to provide communication between the interior of the cabinet and a duct 16 which extends under the floor and behind the rear wall of the interior cabinet to a cavity formed above the top wall of the interior of the cabinet. A fan 17 is arranged to draw air from the cavity through a hepa filter 18 to create a downward laminar flow inside the cabinet 10. The air is then drawn through the apertures 15 in the floor and recirculated.

The cabinet 10 may be arranged to draw a percentage of filtered air from the environment to compensate for losses and

to help maintain the air quality inside the air cabinet.

The heater 14 is connected to a temperature control circuit arranged to maintain a constant temperature of 37°C on the floor of the interior of the cabinet 10.

One end of each duct 12 is connected to an aperture 19 formed in respective side walls of the cabinet 10 and closures (not shown) are provided at opposite ends of the ducts 12 to close the passageways therethrough.

The opposite end of each duct 12 is connected to a corresponding aperture in the side wall of the respective outer cabinet 11. Each outer cabinet 11 comprises a sealed interior compartment and a transparent front wall 20 which allows the interior of the compartment to be viewed. A pair of ports 21 are provided in the front wall 20 of the cabinet 11, through which a person is able to insert their respective arms into the interior of the cabinet 11. The ports 21 may be provided with gloves or sleeves which serve to provide isolation between the interior and exterior of the cabinet 11.

A plurality of controls 22 are provided on the cabinet 11 for controlling the temperature, humidity and pH levels inside the cabinet 11. The pH of the cultures inside the cabinet 11 may be controlled by altering the levels of gases, such as carbon dioxide, within the cabinet. The level of oxygen may also be controlled, so that the gas concentrations within the cabinet 11 resemble that inside the womb. Monitors and alarms may be provided for monitoring the respective levels inside the cabinet.

A microscope (not shown) may also be provided to enable cultures within the cabinet 11 to be examined.

In use, the oocytes collected from the female patient are transferred directly on a dish into the open-fronted

cabinet 10, where the dish is placed on the floor of the interior cabinet above the heater 14, which maintains the temperature of the oocytes at 37°C (i.e. at a temperature which is substantially similar to that inside the female body). The oocytes are then washed and counted and, if necessary, the oocytes are kept inside the cabinet 10 until a sufficient number have been collected. This whole process may take 15 minutes or so but it will be appreciated that the laminar airflow inside the cabinet 10 is clean and serves to contain the oocytes in a stable environment which is substantially isolated from the room environment.

Once a sufficient number of oocytes has been collected, they are mixed with spermatozoa prior to transfer into one of the outer cabinets 11.

In order to transfer the cultures into one of the outer cabinets 11, the door at the inner end of the passageway connecting the cabinets 10, 11 is opened and the cultures are then placed in the duct 12 before the door is closed. The air inside the sealed duct is then brought up to the same environmental conditions as that inside the outer cabinet 11 before the door from the duct 12 to the outer cabinet 11 can be opened.

The cultures are then kept in the outer cabinet 11 in an environment having a stable temperature, pH and humidity, closely resembling the conditions inside the human body. The fertilised oocytes and the resultant embryos can readily be inspected through the transparent front wall 20 of the cabinet 11 without the need to remove them from the cabinet, thereby avoiding disturbance of the environment therein.

A microscope or other inspection tool may also be provided to facilitate inspection of the cultures inside the

cabinet 11. The ports 21 in the front wall of the cabinet 11 also enable the cultures to be manipulated by hand.

Once an embryo is ready for implantation, it can be removed from the cabinet via the duct 12 in the reverse manner to that as hereinbefore described. In this manner, any cultures remaining inside the cabinet 11 are not disturbed while the cultures are removed.

An apparatus in accordance with this invention is relatively simple in construction yet substantially improves the success rate of the IVF procedure.